PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G01S 13/00

A1

(11) International Publication Number: WO 00/60374

(43) International Publication Date: 12 October 2000 (12.10.00)

(21) International Application Number: PCT/US00/08931

(22) International Filing Date: 4 April 2000 (04.04.00)

(30) Priority Data:
09/287,802 7 April 1999 (07.04.99) US

(71) Applicant: OTIS ELEVATOR COMPANY [US/US]; Snyder, Troxell, K., 10 Farm Springs Road, Farmington, CT 06032–2568 (US).

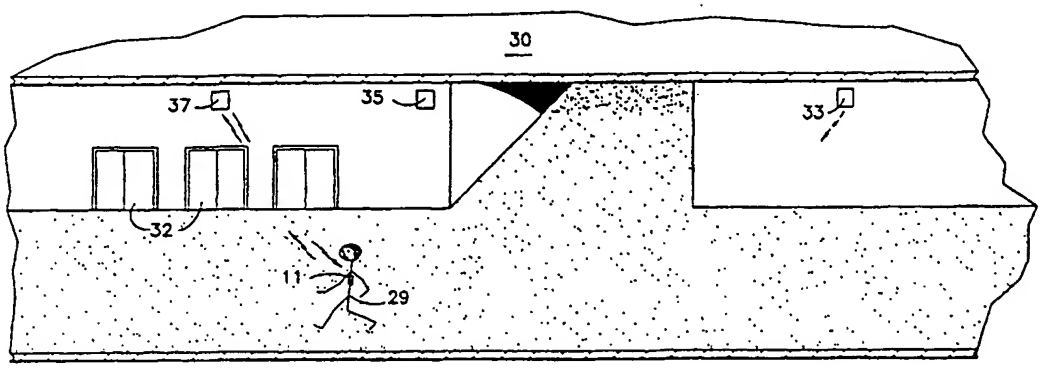
(72) Inventors: WINSTON, Charles, R.; 109 Cambridge Drive, Glastonbury, CT 06033 (US). MORGAN, Robert, G.; 2 Pond View Road, Bolton, CT 06043 (US).

(74) Agent: SNYDER, Troxell, K.; Otis Elevator Company, 10 Farm Springs Road, Farmington, CT 06032 (US).

(81) Designated States: CN, GB, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: PASSIVELY POWERED, PORTABLE REMOTE DEVICE



(57) Abstract

A portable remote device (11) includes a far call transmitter which may be part of a transceiver (24) responding to a beacon (33), or may be a transmitter (24a) responding to a switch (39), or both, so as to provide any or all of: panic alarms, calls for elevator service, authentication, access to vehicles, or access to buildings, garages or other spaces. The device (11) also has a RFID portion (13) which, when near the elevator, vehicle, garage or other space, responds to a beacon (37) utilizing power provided by the beacon in a conventional fashion, whereby to assure access even though a battery (26) of a transceiver (24) or a transmitter (24a) may have failed. Instead of a battery (26), the transceiver (24) or the transmitter (24a) may instead be powered by a stored energy section (20a) of the RFID portion (13) of the device (11), or by a microgenerator (26b), thereby eliminating the need for a battery. The far transceiver or transmitter may be automatically turned off after use, and turned on by the RFID in response to a beacon.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

PASSIVELY POWERED, PORTABLE REMOTE DEVICE

TECHNICAL FIELD

This invention relates to a portable remote device, such as may be used to call elevators for service, unlock automobiles, open doors, and the like, which utilizes a radio frequency identification device (RFID), to assure operability notwithstanding failure of its internal power source, and/or to reduce or avoid the use of batteries, thereby reducing damage to the ecological environment.

BACKGROUND ART

In commonly owned, copending U.S. patent application Serial No. (OT-4360), filed on November 9, 1998, there is disclosed a portable device, carried by potential elevator passengers, which automatically enters a request for elevator service in response to a beacon prompt, from a beacon located ten or more meters from the elevator. The beacon prompt includes a message portion identifying the beacon, whereby the portable device, when it transmits its request for service, can identify the beacon to which it is responding, thereby providing the elevator controller with information as to the floor to which service must be provided. This allows the elevator controller to enter a call, which in that embodiment includes the destination of the passenger, so as to provide favorable assignments of elevators to answer the various calls. In that system, a beacon close to the elevator will cause the portable device to again transmit, and identify the fact that it has been excited by a beacon near the elevator. This allows the controller to know that the passenger has reached the elevator, and has not changed his mind about using it. Similarly, when passengers enter the elevator car, the portable devices may again be interrogated and again identify the fact that they have been interrogated by a beacon within the elevator car itself. This allows the controller to cancel the destination stop for that passenger, if the passenger has not entered the elevator, as well as to perform other control functions.

In such a system, various levels and types of security may be employed: for instance, it is quite possible that there is no way to call an elevator without use of a portable device which has a proper access code, such as a PIN number, in its messages. In such a case, should the power supply of the portable device fail, the potential passenger is effectively locked out. Another problem with such devices is that the use of batteries continues to provide waste which is detrimental to the ecological environment. Furthermore, due to the device being in a "sleep" mode all the time (24 hours a day) so it can sense the beacon prompt and become fully operational, the battery power consumption can be significant. There are other applications, such as panic alarms, unlocking vehicle doors and trunk lids, opening garage doors, and the like, in which loss of portable device power could cause a lockout.

DISCLOSURE OF INVENTION

Objects of the invention include provision of portable, remote control devices in which failure of the portable device power source will not result in a lockout, which do not waste power in a sleep mode, and which do not require batteries.

This invention is predicated on the fact that a radio frequency identification device (RFID) can operate with no power source, being powered totally by energy in received electromagnetic (RF) radiation.

According to the present invention, a portable remote access device includes a RFID which is triggered to transmit a command message, such as a request for access or a panic alarm, in response to reception of electromagnetic radiation from a beacon, the portable device utilizing at least a portion of the received RFID electromagnetic radiation to provide the power to transmit the message; the RFID is combined with a more powerful transmitter, referred to herein as a "far transmitter", which provides early commands, such as an early placement of an elevator call while a passenger is ten or more meters from the elevator, or a command to open a garage door as a vehicle is traveling toward a garage, or to unlock a vehicle, which functions are at too great a range to be responsive to the RFID. In further accord with the invention, the far transmitter portion of the portable

device may be powered by a battery to provide early commands, when operating properly in response to the portable device's own source of power (such as a battery); when close enough, the RFID can register a call, unlock a vehicle or open a door, etc., in response to a beacon, even though the power source (battery) of the far transmitter has failed. In accordance further with the invention, a far transmitter in a portable device may be set into a totally-off mode, to conserve battery or other power, and it may be awakened by the RFID portion of the device, after which it will transmit a command. In still further accord with the invention, instead of a battery, the far transmitter may use a microgenerator, which is a device such used in upscale wristwatches to convert the kinetic energy in the motion of the wearer into stored electrical energy.

In accordance with the invention, the far transmitter (and associated receiver, if desired) may be powered by energy received from a beacon such as a RFID beacon and stored within the portable device at various times when the device is near any beacon, and consumed at various other times whether the device is or is not near a beacon, thereby eliminating the need for batteries altogether.

In accordance with the invention further, the far transmitter (and receiver) may be powered by a conventional micro-generator, such as is currently used to power watches.

Other objects, features and advantages of the present invention will become more apparent in the light of the following detailed description of exemplary embodiments thereof, as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a high level, functional block diagram of a first embodiment of a portable device according to the invention, partially powered by a battery and responsive to at least two beacons.

Fig. 2 is a high level, functional block diagram of a second embodiment of a portable device according to the invention, partially powered by a battery and responsive to activation of a switch and at least one beacon.

Fig. 3 is a high level, functional block diagram of a third embodiment of a portable device according to the invention, powered only by electromagnetic radiation received from an RFID beacon, and also responsive to at least one additional beacon.

Fig. 4 is a high level, functional block diagram of a fourth embodiment of a portable device according to the invention, powered only by electromagnetic radiation received from an RFID beacon, and responsive to actuation of a switch and at least said beacon.

Fig. 5 is a partial, perspective view of corridors of a building employing the invention to place an early call for elevator service from a distance.

Fig. 6 is a partial, perspective view of corridors of a building in which a remote device of the invention is utilized to either verify an earlier-placed call for elevator service, or to initiate a call for elevator service in the event that battery power has failed.

Fig. 7 is a perspective view of a home in which an embodiment of the invention is used to derive access.

Fig. 8 is a perspective view of a vehicle in which an embodiment of the invention is used to derive access or operate a panic alarm.

Fig. 9 is a high level, functional block diagram of a fifth embodiment of a portable device according to the invention, in which the RFID turns on the other circuits of the device.

Fig. 10 is a high level, functional block diagram of a sixth embodiment of a portable device according to the invention, partially powered by a micro-generator.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Fig. 1, a portable remote access device according to the present invention, generally referred to as "device 11", the embodiment of which in Fig. 1 is device 11a, includes a case 12 within which is disposed a RFID 13, which has a functional range of several meters, and a more powerful far transmitter 14 which has a range of several tens of meters. The RFID 13 is conventional, having an antenna 17 connected to a transmitter 18, a receiver 19, and a power section 20. The power section 20 extracts the power necessary to operate a microprocessor 21, the transmitter 18 and the receiver 19 directly from the electromagnetic radiation received at the antenna 17 from a RFID beacon. The

RFID 13 is conventional: upon receipt of a pulse of electromagnetic radiation, typically at a frequency of about 125 KHz, the receiver 19 activates a wake-up interrupt in the microprocessor 21 which formulates a coded return message for transmission by the transmitter 18, typically only identifying the particular RFID which has been interrogated; however, in this invention, the RFID transmission will typically include a command portion. As is known, since the power for the RFID is provided completely by received electromagnetic radiation, no internal power source is required. According to the invention, the far transmitter typically is SAW (surface acoustic wave) stabilized, operating at 315 MHz with a range of several tens of meters. The transmitted message will typically include a command portion, such as to call an elevator to a given floor, open a door, etc. and may include a device identity portion, such as to signal an elevator destination floor. In some embodiments of the invention, the transmissions may be encrypted, such as in a manner set forth in U.S. Patents 5,363,448 and 5,377,270; however, in embodiments of the invention utilized to place unsecured elevator calls, encryption is not required. In the embodiment of Fig. 1, the transmitter is part of a transceiver 24, which will typically have its own antenna 25 so as to maximize performance at the related frequency, and its own microprocessor. In the embodiment of Fig. 1, the transceiver 24 is powered by a battery 26.

The embodiment of Fig. 1 may be utilized in a fashion illustrated with respect to Figs. 5 and 6. In Fig. 5, the portable remote access device 11 of the invention is being carried by a potential passenger 29 as he enters a building 30. At some distance from a bank of elevators 32, which may be on the order of 10 or 20 meters, an RF beacon 33 transmits an interrogation message at the frequency of the transceiver 24. In a typical embodiment, the message from the beacon 33 will include a beacon identification tag, as set forth in commonly owned, copending U.S. patent application Serial No. (OT-4387), filed November 2, 1998. The beacon tag in the message from the beacon 33 is retransmitted, along with the identity of the passenger 29, by the transceiver 24 for receipt by a receiver 35. The beacon tag allows the transceiver 24 to identify the beacon 33, and therefore the floor of the building on which the potential passenger 29 is located, so that the passenger's

presence will not be related to any other floors of the building, notwithstanding the strength of transmission of the transceiver 24. The receiver 35 provides the floor and passenger identification information to a dispatching controller so as to enter a request for elevator service, which may typically include the destination floor as well as the origin floor on which the passenger 29 is located. However, the dispatching controller will not cause the assigned elevator to stop at that floor for the passenger 29 unless it subsequently learns that the passenger 29 has arrived at the elevators, as illustrated in Fig. 6. Therein, a RFID beacon 37 periodically transmits a beacon message which will be received by the RFID portion 13 of the portable remote access device 11, which in turn causes the device 11 to transmit a response back to the beacon 37. This differs from operation in the aforementioned application (OT-4360); in that application, the same transmitter and receiver handle the far or early request and the near or confirming request in response to two different beacons; herein, the early request is sent by the far transmitter within the transceiver 24, whereas the near request or confirmation is provided by the RFID 13 in response to its own beacon 37.

In accordance with the invention, should the battery 26 fail, the transceiver 24 will be unable to respond to the beacon 33 so as to place the early call for the elevator as seen in Fig. 5. However, when the passenger approaches the bank of elevators 32 as shown in Fig. 6. interrogation by the RFID beacon 37 will cause the RFID portion 13, being powered solely by received electromagnetic radiation, to provide a late call for the elevator. The result is the same, except for the fact that the potential passenger 29 will have to wait longer for an elevator to be assigned to respond to his call.

Referring to Fig. 2, a portable remote access device 11b in accordance with a second embodiment of the invention has a transmitter 24a in place of the transceiver 24 of Fig. 1, and instead of being activated by a beacon (such as beacon 33 in Fig. 5), is activated by a switch 39. The embodiment of Fig. 2 may be used to call elevators in the same fashion as described with respect to Fig. 5, except that instead of being automatically operated by the beacon 33, the potential passenger 29 will press the switch 39 at some point, as he approaches an elevator from which service is desired. The transmitter may be set into a

totally off-state after each transmission, so as to conserve power, and the switch 39 may engage the power, wake up the transmitter and cause the transmission of a command. The embodiment of Fig. 2 is also suited to open garage doors 40, 41 as shown in Fig. 7. Each door is operated in a conventional fashion by an operator 42, 43 which can receive the far signal from the transmitter 24a disposed within a device 11b in a vehicle 46. Should the battery 26 or other power source fail, so there is no far transmission from the transmitter 24a, nonetheless as the vehicle 46 approaches the doors 40, 41, an RFID beacon 47 will interrogate the RFID portion 13 of the device 11b, causing a response which will open either or both doors (as desired), thereby providing access even with a battery 26 which has failed. The RFID beacon 47 may be arranged to transmit periodically only at certain times, such as when an alarm system within the house is armed as could be the case when nobody is in the house.

The device of Fig. 2 may be used to unlock vehicle doors and trunk lids, in a fashion similar to that described for garage doors, as shown in Fig. 8. A vehicle system may employ a beacon 50 within the vehicle 51, so that if the far transmitter 24a were inoperable in response to the switch 39 due to loss of battery or other power, a beacon may activate the RFID portion 13, and thereby provide access to the vehicle 51.

A different aspect of the invention is illustrated in Figs. 3 and 4 which are identical to Figs. 1 and 2, respectively, except for the fact that no battery 26 is provided, and instead a line 26a is provided from the power section 20a of the RFID portion 13a of the device 11c, 11d. In each case, the power section 20a is modified so as to store all energy in excess of that required to cause the RFID 13a to respond to a beacon, in capacitors, or in some other conventional fashion, and to not discharge the power capacitors, as typical RFIDs do following a transmission. This energy will be saved for use thereafter. If the device is used to provide elevator calls, an RFID beacon, similar to the beacon 37, located within each elevator car will provide charge to the unit during the tens of seconds that the passenger 29 is riding within the elevator car. Similarly, the devices may be charged by being left near a beacon in a garage, or in a vehicle, such as an RFID beacon that interrogates an ignition key (for security) which contains a remote device 11.

In the vehicle which has a RFID chip in the head of the ignition key, with an encryption response message to assure that the key is an authorized key, a device of the invention hanging on the same key ring can likely be charged by the RFID beacon associated with the ignition. Of course, the device may itself be formed within a molded head of the ignition key itself, thereby requiring only a single unit be carried around to gain access to the vehicle, to operate the vehicle, to call an elevator, and to operate the garage doors. This aspect of the invention, totally eliminating the battery, eliminates dependence on batteries and reduces damage to the ecological environment as a consequence of waste battery disposal.

In the devices of Figs. 3 and 4, the transceiver or transmitter may share the microprocessor 21 of the RFID, instead of having one of its own, if desired.

Another embodiment of the invention, shown in Fig. 9, is exactly the same as Fig. 2 except that the transmitter 24b need not be awakened by the switch 39, but is awakened by a signal on a line 55 from the microprocessor 21 of the RFID 13b, in response to a beacon signal received by the RFID. In this way, the transmitter 24b can be put into a totally-off mode so that no power is consumed from the battery 26. Upon passing by a transmitting beacon (such as beacon 33 in Fig. 5), whether or not the RFID 13b transmits a reply, the microprocessor 21 thereof will send a signal on the line 55 to awaken the transmitter 24b, so that it then starts to draw power from the battery 26, and either transmits a reply or waits for another beacon to alert it to transmit a reply. Of course, the transmitter 24b need not have a switch 39, in any case, as desired.

In Fig. 10, the portable device 11e is identical to that of Fig. 2 except that a microgenerator 26b provides power instead of a battery 26. The microgenerator 26b is of a conventional type currently in use in upscale wristwatches. So long as there is some minimal amount of motion of the device 11e, the microgenerator will produce electricity, which, when aggregated in storage devices such as high quality capacitors, will provide sufficient power for the transmitter 24a to transmit a command. The microgenerator 26b may be utilized in an embodiment similar to Fig. 1, in which a transceiver receives a beacon prompt before transmitting. The microgenerator 26b may be used in an

embodiment similar to Fig. 9 in which a signal on the line 55 from the microprocessor 21 will wake up the transmitter 24a, thereby avoiding power drain during a "sleep" mode. In such a case, the switch 39 may be eliminated unless it is needed for non-beacon applications (e.g., opening doors) which are provided in a combined device in addition to the beacon applications. Of course, any of the features of any of the embodiments may be selectively combined to suit any particular utilization of the invention.

The invention has been described as being useful for gaining access to elevators, garages and vehicles; of course, the embodiment of Fig. 1 could be provided with a switch as in Fig. 2, and the embodiment of Fig. 3 could be provided a switch as in Fig. 4, so that either of these combined embodiments could be used for passive elevator calls and panic alarms, as well as switch-initiated access to vehicles, garages and other confined areas. In any case of gaining access to protected spaces, each message should have an encryption portion to provide security, and in order to enable placing an elevator call with a correct destination (if such is desired), each message should include an identity portion.

Although the invention has been shown as having the two portions of the device in a single case 12, such need not be the case in the embodiments of Figs. 1, 2 and 10, and in other embodiments where the far transmitter/transceiver is not dependent on the RFID. As an example, the RFID may be embodied in a car key and the transmitter/transceiver may be embodied in a key fob on the same ring, or in an employee ID badge, or otherwise, with the RFID in a key or a key fob, or otherwise.

The description thus far utilizes simple commands and simple relationships between the RFID portion and the transmitter/transceiver portion. However, the RFID may receive information for altering the messages or other parameters of operation of the transmitter/transceiver, and vice versa. The manner of response of either portion may depend on data received from the other portion, either unsolicited or in response to a query. Either or both portions may be reprogrammable, in response to information received by either.

Similarly, the invention may be practiced with or without a variety of other features. The radiation may be infrared, or any suitable wavelength. The messages transmitted by the

RFID and/or by the far transmitter may be simple authentication codes, or such codes coupled with any sort of command. The energy storage device need not be part of the RFID portion, and it may store energy derived from electromagnetic radiation from transmitters that are not RFID beacons. Other switches may be added to control functions in both positions.

The aforementioned patent and patent applications are incorporated herein by reference. Thus, although the invention has been shown and described with respect to exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions may be made therein and thereto, without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A portable remote apparatus comprising:

a RFID portion responsive to electromagnetic radiation received from at least one RFID beacon to provide circuit operating power for said RFID, utilizing power derived from said electromagnetic radiation;

a far transmitter operable when activated to provide an electromagnetic transmission comprising at least one of an elevator call, authentication, a request for an alarm, and a request for access to a space, said transmission having a range in excess of the range of said RFID;

a power source for said far transmitter; and

means operable to activate said far transmitter.

2. Apparatus according to claim 1 wherein:

said power source comprises a battery within said device.

3. Apparatus according to claim 1 wherein:

said power source comprises an energy storage section for storing energy derived from electromagnetic radiation transmitted in the vicinity of said device.

4. Apparatus according to claim 3 wherein said energy storage section is part of said RFID portion.

5. Apparatus according to claim 3 wherein said energy storage section stores energy derived from said at least one RFID beacon.

6. Apparatus according to claim 1 wherein:

said power source comprises a microgenerator within said device.

7. Apparatus according to claim 1 wherein said means operable to activate said far transmitter comprises a human-operable switch.

8. Apparatus according to claim 1 wherein said far transmitter comprises a portion of a transceiver responsive to a far beacon transmitting interrogation messages at a frequency to which said transceiver is responsive, and said means operable to activate said far transmitter comprises the receiver portion of said transceiver operable in response to receipt of an interrogation message.

9. Apparatus according to claim 1 wherein said means operable to activate said far transmitter comprises a circuit associated with said RFID portion to activate said far transmitter in response to said electromagnetic radiation received from said RFID beacon.

10. Apparatus according to claim 1 wherein said power source is selected from a battery and a microgenerator, said far transmitter comprises means for placing said far transmitter into a totally-off mode following each said transmission thereby to conserve power from said source, and said far transmitter comprises a circuit associated with said RFID for placing said far transmitter into an on mode in which said far transmitter will provide said transmission.

11. Apparatus according to claim 1 wherein said space is within a vehicle.

12. Apparatus according to claim 1 wherein said space is within a building.

13. Apparatus according to claim 12 wherein said space is within a vehicle garage.

14. Apparatus according to claim 1 wherein said RFID portion is responsive to electromagnetic radiation received from an RFID beacon to transmit a message, said

message selected from an elevator call, authentication, a request for an alarm, and a request for access to an area.

15. Apparatus according to claim 14 wherein said area is within a vehicle.

16. Apparatus according to claim 14 wherein said area is within a building.

17. Apparatus according to claim 16 wherein said area is within a vehicle garage.

18. Apparatus according to claim 14 wherein said area is said space.

19. Apparatus according to claim 1 wherein said RFID portion is responsive to electromagnetic radiation received from an RFID beacon to transmit a message related to said electromagnetic transmission of said transmitter, and said RFID portion is physically separate from said far transmitter.

20. Apparatus according to claim 1 wherein said RFID portion and said transmitter are disposed in the same case.

FIG.1

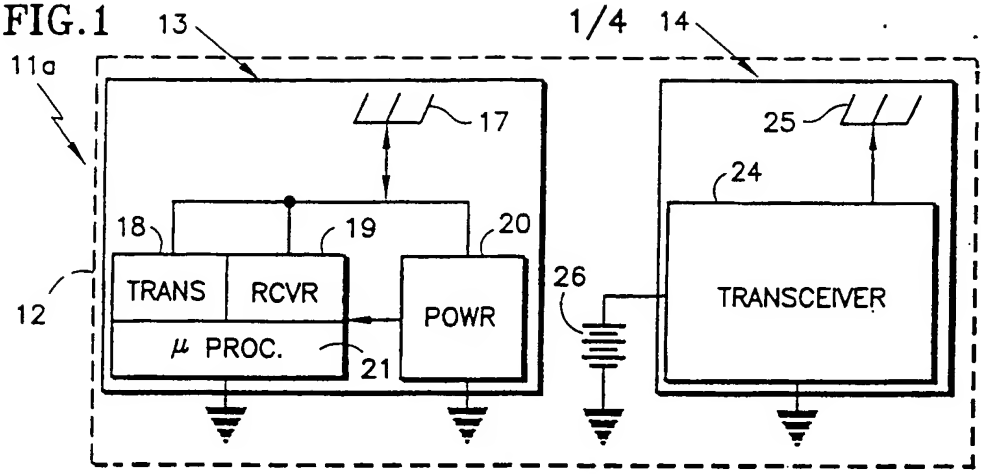


FIG.2

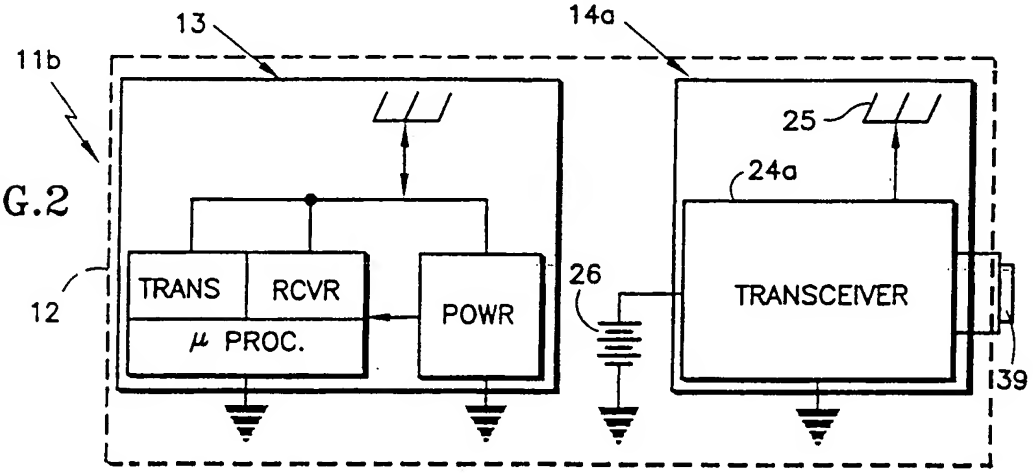


FIG.3

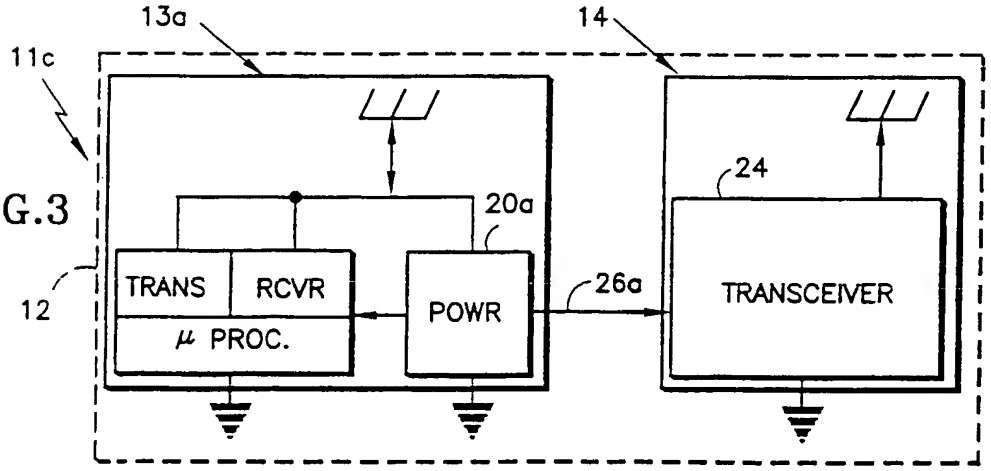
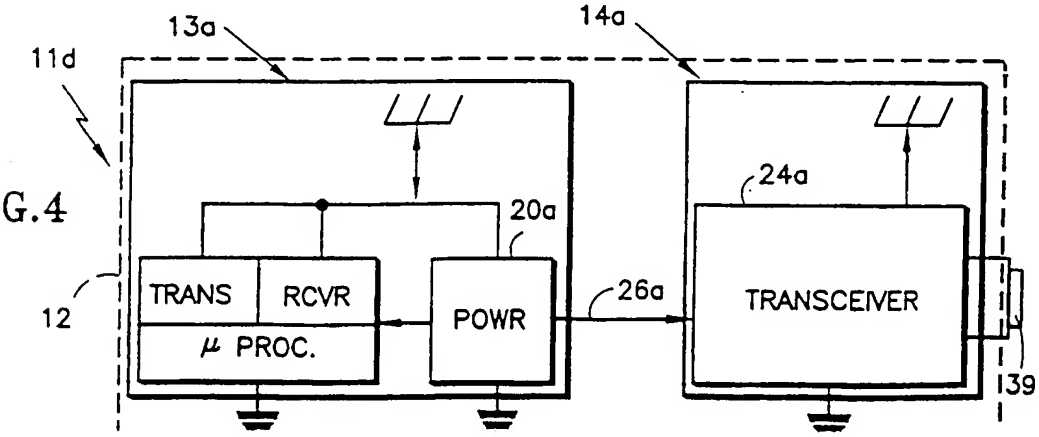
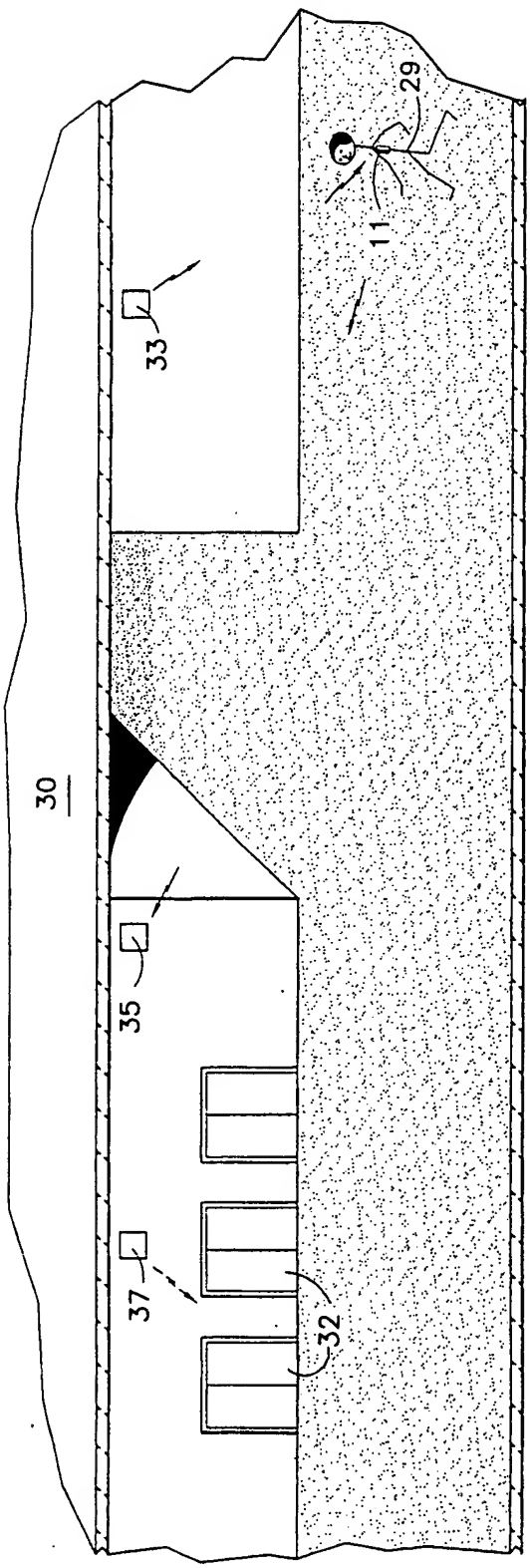
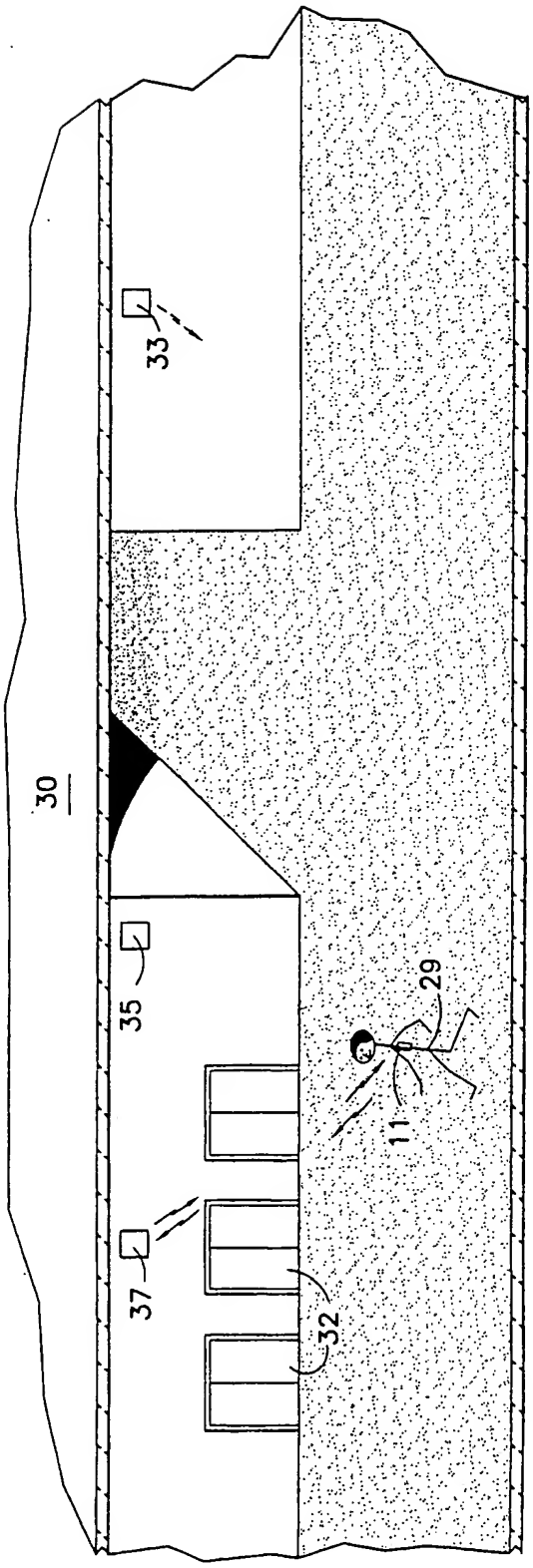


FIG.4





IG.5



'IG.6

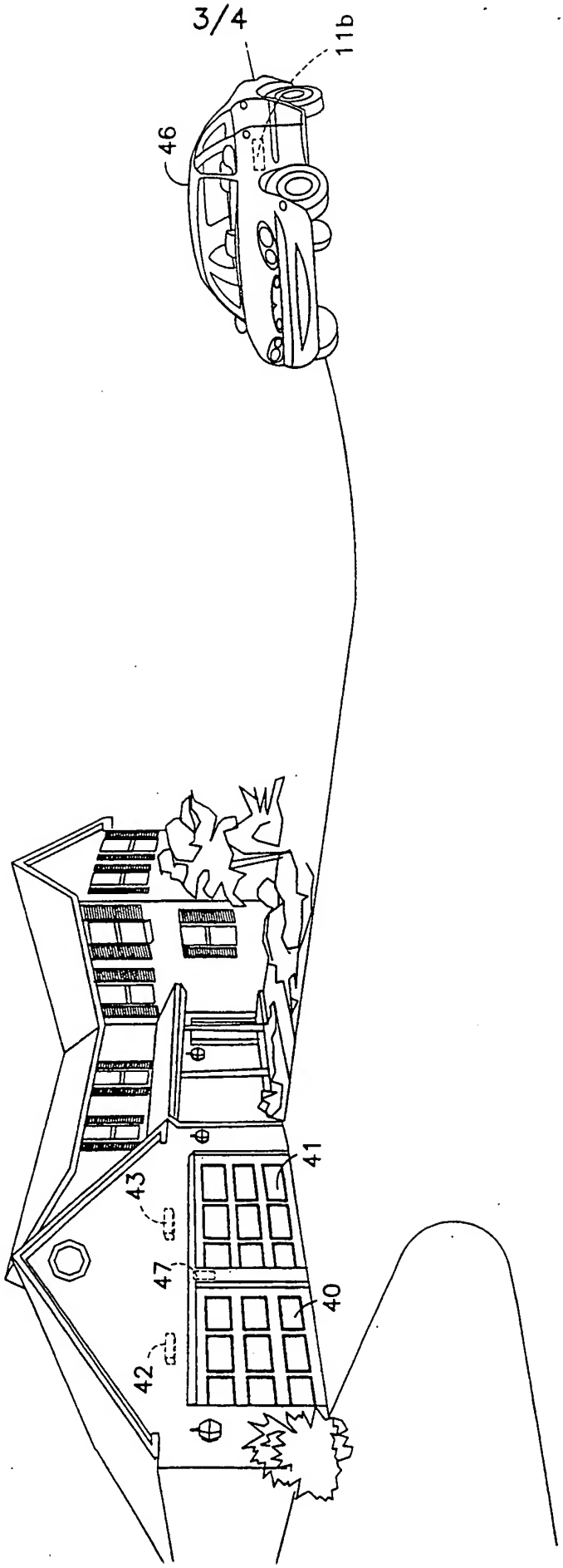


FIG.7

FIG.8

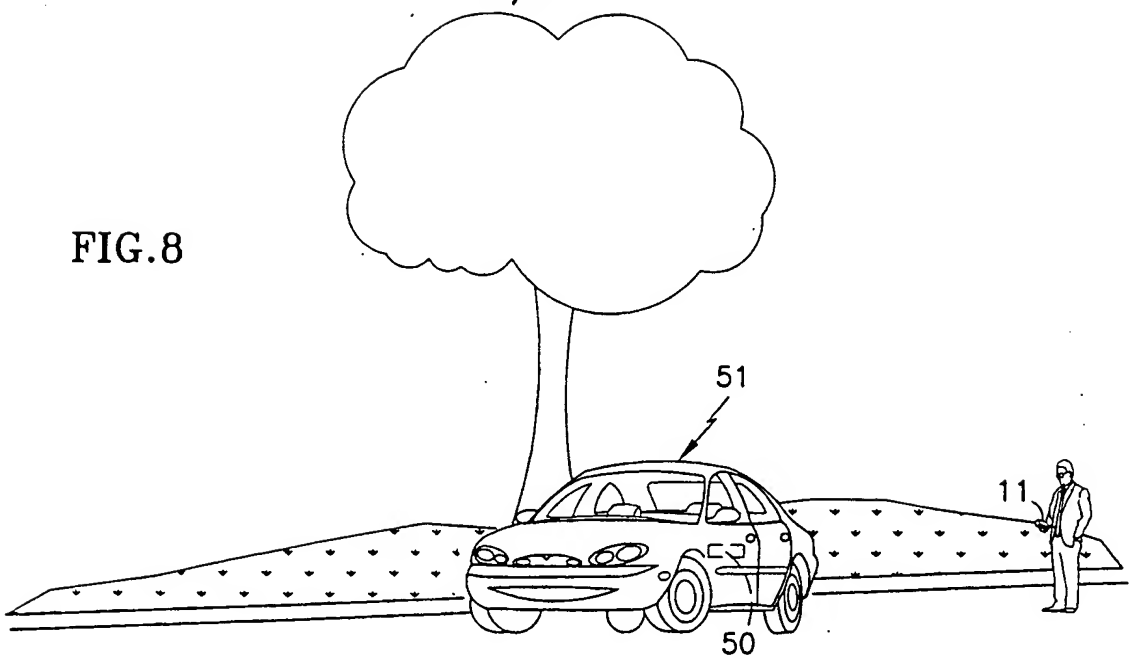


FIG.9

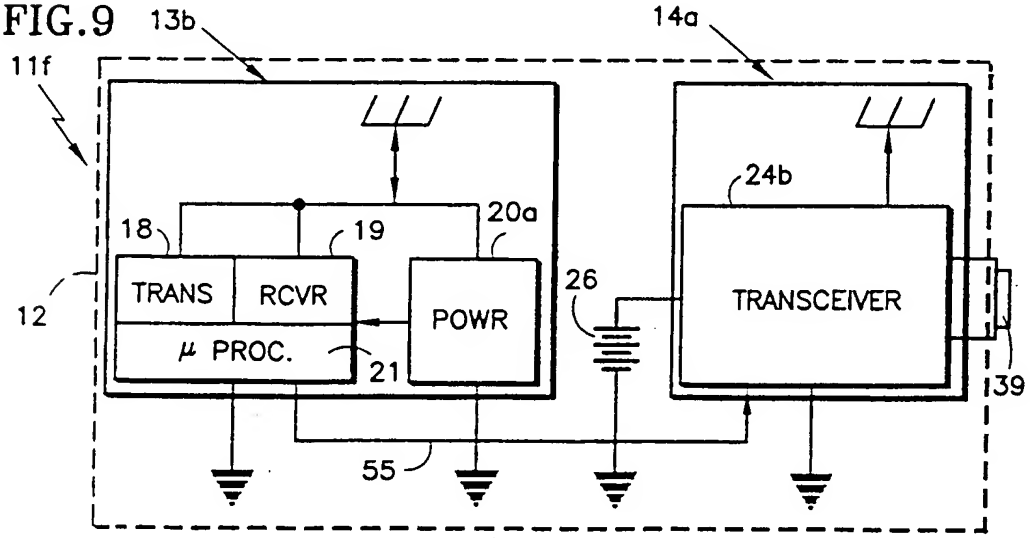
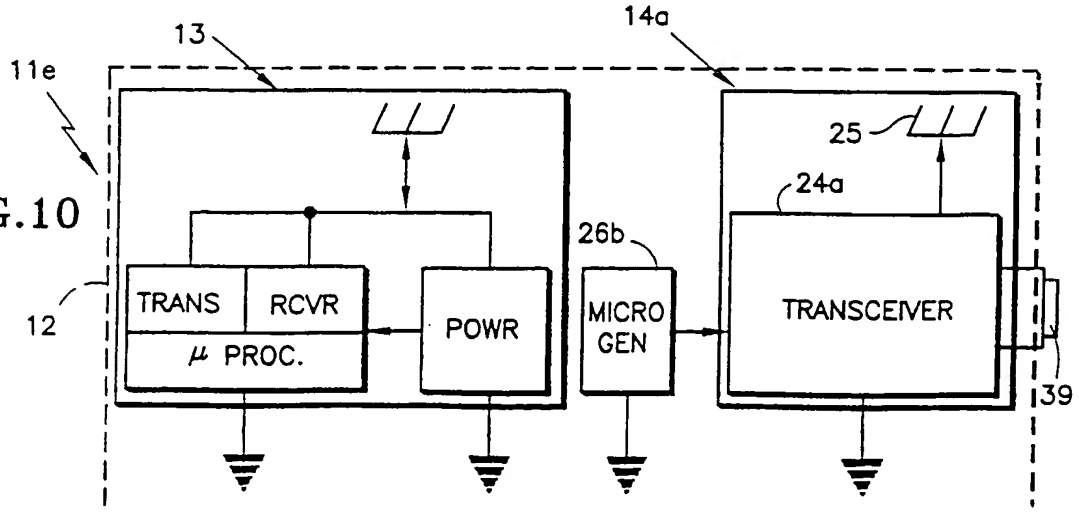


FIG.10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/08931

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :G01S 13/00
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/10.1,10.30,10.31,10.32,10.33,10.4,10.42,10.52; 340/571,572; 340/825.04, 342/42, 51

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

West: (transceiver adj electromagnetic) and power

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,870,419 A (BALDWIN et al) 26 September 1989, abstract, & col. 7, lines 50 - 59.	1-20
Y	US 4,973,958 A (HIRANO et al) 27 November 1990, abstract, & col. 2, lines 30-54.	1-20
Y	US 5,517,188 A (CARROLL et al) 14 May 1996, abstract	8
Y,P	US 5,920,287 A (BELCHER et al) 06 July 1999, abstract, & col. 1, lines 34-42	10
Y	US 4,988,992 A (HEITSCHEL et al) 29 January 1991	12,13, & 16-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 MAY 2000	19 JUL 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer ANTHONY A. ASCHWANDEN James R. Matthews Telephone No. (703) 305-4071

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/08931

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

340/10.1,10.30,10.31,10.32,10.33,10.4,10.42,10.52; 340/571,572; 340/825.04, 342/42, 51